# SCIENCE

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## THE FUTURE OF SYSTEMATIC BOTANY.[1]

THE address of Vice-President Coulter was a departure from the custom of presenting either an interesting bit of research or a summarized view of information concerning some subject. The speaker invited the attention of the section to an ancient department of work. The ancient history of systematic botany is too well known, he said, to need even brief repetition, but the one desire which runs with increasing force through it all is to reach eventually a natural system of classification. At first, from necessity, plants were simply systematically pigeon-holed for future reference, and those who could thus dispose of plants were known as "systematic botanists," an appellation proper enough, but one unfortunately not having sufficiently outgrown its original application. The unfortunate result of this early necessity of so rigidly systematizing facts and thus rendering them accessible was to make the pigeon-holes as permanent as the facts they were intended temporarily to contain.

As soon as knowledge justified the attempt, "natural systems" of classification began to be proposed; and one natural arrangement has succeeded another, from that day to this, until in those of to-day we have presented simply what the earliest contained, viz., the expression of man's knowledge of affinity, the difference being a slowly diminishing amount of artificial padding.

Systematic botany, as formerly understood, has probably done all that it could, unaided, in the natural arrangement of plants. It could indefinitely juggle with sequences and nomenclature, but this is of secondary importance when the real purpose of systematic botany is considered. But it was not left without aid, and a group of new departments was made possible by the microscope and the unexampled progress of powers and manipulation. The study of the cell and of nascent and mature organs, and the recognition of plants as living things that are the resultant of the interplay of internal and external forces, have revivified the ancient mummy called botany, and have made it a living thing, capable of endless development.

Some one has said that "the highest reach of the human mind is a natural system of classification." This simply means that when the results of all departments of botanical work are well in hand, then the systematists will be in a position to put on a sure foundation the structure they have always been planning. The real systematic botany, therefore, is to sum up and utilize the results of all other departments, and its work is well-nigh all in the future. It is bound to be the last expression of a human thought with reference to plant life, just as it was the first. The systematic botany which deals with genetic characters and recognizes the fact that every plant is a living thing, with a history and all degrees of consanguinity, and that the final form of every natural classification must be to approximate to the order of descent, is in its early infancy.

[1] Abstract of an address before the Section of Biology of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19-25, 1891, by John M. Coulter, vice-president of the section.

The position then taken by the speaker was that for the systematists of to day and of the future there must be three distinct lines of work, related to each other in natural sequence in the order presented, and each turning over its completed product to the next.

The preliminary phase of systematic botany, the collection and description of plants, is that which most frequently stands for the whole in the popular mind. The speaker explained the disrepute into which it seems to have fallen in certain scientific quarters by the fact that this popular impression was resented. He spoke of the inspiring nature of the pursuit after new species, and said that it sometimes became almost a mania, or too attractive to the incompetent. But even this ancient kind of work sadly needs improvement. Many things besides the mere sporadic collection and recording of species should be included as legitimately belonging to this line of research. A plant is too often a text without any context, and is thus robbed of much of its significance. Nothing seems more unsystematic than field-work in systematic botany. All information that can be obtained in the field concerning species is the province of the collector to procure and of the taxonomist to record. The speaker protested against the search for species as for diamonds, as things solely valuable in themselves apart from their surroundings, and he urged the conversion of collecting trips into biological surveys. He expressed great gratitude to the noble army of self-denying pioneer collectors, but claimed that the time had now come when the same amount of labor could be expended to better advantage, and that a race of field-workers must be trained who shall follow their profession as distinctly and scientifically as the race of topographers. "In this centre of public scientific work in which we have met, devoted to obtaining the largest amount of information in regard to our material possessions, and with means commensurate with the largest plans, it seems an appropriate thing to urge a thoroughly equipped system of biological surveys. This subject is not a new one here, and steps have already been taken to organize some work of this kind, but I desire to voice the sentiment of this section in commending all that has been done in this direction, and in urging that the organization be made more general and extensive."

In reference to the work of description, the speaker read an unpublished note of Professor Asa Gray, in which that distinguished botanist lamented the work of those who were incompetent. The speaker also expressed the opinion that the exclusive use of gross organs in the description of higher plants would be given up, and that the more stable, minute characters would prove valuable aids in studying diagnosis. A danger in the use of these minute characters was pointed out, viz., the tendency to use a single set of minute characters too far, and to make the fabric of a whole group conform to it. The character of a species is an extremely composite affair, and it must stand or fall by the sum total of its peculiarities and not by a single one. There is nothing that involves a broader grasp of facts — the use of an inspiration rather than a rule — than the proper discrimination of species.

"I have dwelt thus upon the work of collection and de-

scription both to magnify it and to indicate that its proper position is that of a preliminary phase in the study of systematic botany."

The work of searching for the affinities of great groups is the crying need of systematic botany to-day. The speaker called attention to the danger of magnifying the importance of certain periods or organs in indicating affinities, and summed up what was said under this head as follows: "I have thus spoken of the study of life-histories to indicate that its chief function lies in the field of systematic botany; to suggest that it take into account development at every period and of every organ, and so obtain a mass of cumulative evidence for safe generalization, and to urge upon those not thoroughly equipped great caution in publication."

The speaker spoke of the necessity of constructing a natural system with easy advance in the knowledge of affinities, as a convenient summary of information, a sort of mile-post, to tell of progress and to direct future effort. The concluding summary was as follows: "The points presented in this consideration of the third phase of systematic botany are that the last and highest expression of systematic work is the construction of a natural system, based upon the accumulations of those who collect and describe, and those who study life histories; that this work involves the completest command of literature and the highest powers of generalization; that it is essential to progress for a natural system to be attempted with every advance in knowledge, and that all the known facts of affinity, thus brought within reach, should be expressed in all systematic literature. In conclusion, I have but to say that I have attempted to indicate the true relation which exists among the different phases of systematic botany; to point out an affinity which there is danger of ignoring, and to maintain that all these departments of work, looking to the same end, are equally important, equally honorable."

## THE FARMER AND TAXATION.[1]

QUESTIONS of taxation have played a prominent part in the polity of English-speaking communities for many centuries, and they have not been without importance in the history of other civilized countries as well. A history of English taxation would be in no small part a history of the English people itself.

It was a quarrel about taxation between the nobles and King John which led to the granting of the Great Charter, and thus planted the seeds of modern constitutional government. English liberty indeed has been developed chiefly in connection with disputes about taxation. Charles I. owed the loss of his throne and of his head largely to his determination to levy such taxes as he pleased without consulting the great men of his realm. English obstinacy in regard to the principle of taxing the colonies led to the American Revolution and the disruption of the British Empire. It was at bottom a question of taxation which led to the French Revolution, and the turning and overturning of Europe which has hardly ceased even now. And the history of this century on the continent shows how fundamental tax questions are to the welfare and prosperity of modern nations.

Of late the question has become of even more importance, and has acquired a very different aspect from that of former centuries. The disputes about taxation were, down to a recent date, largely of a political nature. They turned, not so much on the amount of the tax or the manner in which it should be levied, as upon the point who should say whether it should be levied at all or not. The rulers or ruling classes tried to keep the whole question within their own control, and those who were opposed to this were trying to get the right to vote or refuse taxes. Now every civilized country in western Europe and America vests the right to say what taxes should be levied, and how they shall be levied, in the people or their representatives. It is accepted as a definite principle that the people are the sole source of the authority to determine what taxes should be levied.

We have indeed always had that principle accepted in this country, to a greater or less extent, and in all its fulness, ever since the Revolution. People thought formerly that as soon as that principle was accepted tax problems would be solved. But it did not take long to find out how great an error this notion was. Hardly had the principle been accepted as a part of the fundamental law of the country when the representatives of the people found out that they were only at the verge, so to speak, of the question. The political side of the problem had been settled to a certain extent, but that only left room for the economic aspect to appear in sight, with a vast array of the most difficult questions. It soon became evident that under the systems of taxation in existence some people paid more than they ought to, and some paid less. Some classes were taxed but lightly or not at all and others very heavily. Then began the fight between the classes, between those exempted by law and those subjected by law to taxation. This conflict was slowly fought through, and now in nearly all civilized countries there are few classes exempted by law from taxation. But it was soon found that it was not necessary to exempt by law in order to take advantage of circumstances in such a way as to materially lighten one's burdens. Then began another struggle between the various classes as to which could shift the burden of taxation more completely, under the forms of law, to the shoulders of the other. The town was arrayed against the country, the producer against the consumer, the rich against the poor, the laborer against the capitalist, etc. We are still in the thick of this fight, and there is no sign of an end to it. It is raging in all countries alike. Our tax problems are not very different in some of their most important features from the tax problems of England, France, and Germany, and each of these countries can learn something from the experience, the successes and failures, of the others.

The problem is all the more difficult because, even if all parties were willing to do exactly the fair thing, we should still find it difficult to determine exactly what the fair thing is. Where you cannot obtain common consent as to what is fair and proper, we need not expect that private individuals will relax their efforts to get exemptions, and make laws under which they can escape what others may consider their fair share of taxation.

The matter is destined to become more rather than less important, and that from several reasons. In the first place the amount of money to be raised by taxation is destined to increase pretty steadily, if not very rapidly. This fact, of course, makes a bad system of taxation become worse with every increase of the amount. If, for example, we had in this country to raise only a small sum for public purposes, say ten million dollars in all, for federal, state, and local governments, it would not matter much how we raised it. We might have an income tax on all incomes over ten thousand dollars a year, or on all incomes of less than that, or a uniform tax on lands irrespective of their value, or even on polls; and while it might be very unequal, yet the whole

[1] Address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19-25, 1891, by Edmund J. James, vice-president of the section.

amount would be so slight that it would not be worth while complaining about it. Even such a sum as a hundred million a year could be raised very easily by almost any system of taxation. But when you want to raise seven hundred millions it is a very different matter. A system of taxation which would yield a small sum becomes absolutely insupportable when you attempt to raise a large sum by it.

There are some theorists, it is true, who maintain that all the revenues necessary for public purposes could be raised easily by a land tax, or by an income tax, or by an excise tax. Such people have given little study to the organic nature of the State. In determining how much of a burden an organic body can bear, you must consider not only the weight itself but also its distribution. Take a soldier, for example. Would you measure the burden which he could carry in the field by the amount he could drag in the shape of an iron ball attached to one of his feet, or the amount he could carry in one hand, or suspended from one finger? Of course not. Every one recognizes that a load which would tire a man out completely in a few hours if placed on one part of the body can be carried for an indefinite period if only it be properly distributed. So with taxation. Any single tax presses down and destroys or tends to destroy some one part of the economic body. Increase it and you not only destroy that part but, by sympathy, the whole body economic. Given a system of taxation then, which will yield a certain revenue easily without injuring any part of the body economic, if you double the amount to be raised, you will in all probability make the system absolutely insupportable.

Now this is exactly what we have done in this country. We have in essence the same system of taxation which was in vogue a hundred years ago. Indeed we may say that in all its most important features it is the same as was adopted in England in the time of Queen Elizabeth, for our ancestors brought it with them and adopted it almost without change when they settled the country. In the mean time our industry has changed, our agriculture has changed, we have changed our style of dress. We wear different hats, a better boot and shoe; we drive a better horse, milk a better cow, fatten a better hog, have invented a new plough, invented and utilized the railroad, steamboat, mowing-machine, reaper, self-binder, etc., but we stick to an antiquated system of taxation which was not very good at the time it was adopted and has become worse ever since. If we were willing to abolish the public school system entirely, give up trying to improve the roads, starve the inmates of our jails and alms-houses, tie up our insane to a post until they die of starvation and neglect, go back to the fourteenth century system of sanitation, abolish universal suffrage, and set up a class of nobles and kings to rule over us, perhaps we could get money enough out of the community to serve such public purposes as would then be necessary by the system of taxation which we now have. I take it, however, that we are not going to do any of these things. On the contrary, we propose to have better schools, better roads, take better care of our poor, be more reasonable in our treatment of the insane and criminal classes, establish better conditions of public health, do more to develop our industries,— in a word, we propose to advance and not decline in civilization. All this will require more money than we have now, and a system of public revenue must be established which will not only enable us to raise the sums at present demanded but very much larger sums, and at a less cost of effort.

Think for a moment how enormously the expenditure for public purposes has increased of late years in all civilized countries. The ordinary expenditures of the Federal Government for the decade 1791–1800 were about four millions of dollars. For the decade 1870–1879 it was more than forty times as much, while the population was only about twelve times as great. In the State of New York the amount raised by taxation rose from twenty millions in 1861 to fifty millions in 1870; in Massachusetts, from eight to twenty-two millions in the same period approximately; and in Ohio, from eleven to twenty-two. In the fifteen years from 1860 to 1875 the total amount raised by taxation rose in Baltimore by 110 per cent; in Boston, 241; Brooklyn, 313; Chicago, 1445; Cincinnati, 377; Detroit, 384; Louisville, 318; Milwaukee, 326; Newark, 558; New York, 430; Philadelphia, 317, etc. For fourteen large cities the amount of increase was 363 per cent, while the population increased only seventy per cent. Now it is plain that a tax system which might have been at least bearable in 1860 was in all probability out of all reason in 1875, when nearly four times the revenue had to be raised by it.

Taking all the cities in Massachusetts, they paid six dollars per head in taxes in 1861 and over seventeen dollars in 1875. The city debts had increased from less than eight dollars per head to over fifty-four per head. Even if we take the period after the war, from 1866 to 1876, and take the average of 130 cities in the United States, including therefore the smaller ones also, it will be seen that the taxes rose from sixty-four to one hundred and thirteen million dollars. They have not declined since, but have all risen at least as rapidly as the population.

This phenomenon is not by any means confined to our own country but is quite as noticeable abroad. The expenses of Vienna rose from thirty-seven to sixty-seven million francs in the years from 1865 to 1874, Breslau from four to eight, Florence from nine to twenty-four, Berlin from eighteen to forty-six. Paris rose from eighty-three to one hundred and ninety-six million francs in ten years. Thirty-two cities of Prussia increased their taxes eighty-three per cent in seven years.

A moment's reflection will convince any of you of the enormous increase in this burden, even if you did not have these figures.

You all know that the expense for schools has become enormously greater than formerly. Every country district must now have its school taught from five to six months in the year by a teacher who gets on the average nearly twice as much as two generations ago. Every little village must have its system of graded schools, and if it gets a trifle larger, must have its high school. We are now calling for manual training in the schools, and we are no longer satisfied with the horrible accommodations for teacher and pupils which used to satisfy our fathers. Our poor-houses must be at least half-way decent places, our jails are vastly improved, etc. In a word, our expenditures are vastly greater, and consequently the sum of money to be raised by taxation. As a result the revenue system has broken down, and there are loud calls for a better one.

Now in deciding upon a system of public revenue, two things are to be kept in view. We must first of all find out where the wealth is that we wish to reach, and second, we must then adopt the best system we can devise to find and tax that wealth. There is no use of adopting specific taxes unless there is something to be taxed.

Now here is just the difficulty in our present condition. Our tax system does not correspond to our industrial conditions. It was devised in all its essential features over three

centuries ago, and has undergone little change. If we except the indirect taxes like customs duties, our present system is based on the idea that the chief wealth of the country is in its agricultural districts, in its farms, and consequently it is adapted to reach the main elements in such a condition of society. But nothing could be further from the truth. It was so a century ago, but has long ceased to be so.

In 1790 there was no railroad in the country, scarcely any banks, few trades, little manufacturing, scarce a dozen corporations in the whole country, no very large cities, and ninety-seven per cent of the people lived in the country. What wealth there was was in the country — in the farms and lands and farm products. A system of taxation based on this fact worked fairly well.

How is it now? Where is the bulk of the wealth of this great country of ours? It is no longer in the country: it is in the cities, in and around which nearly half the population is aggregated. It is no longer in agriculture; it is in railroads; it is in gas companies, in street-car lines, in merchandizing and trading,— everywhere but in farming. The earnings of the railroads of the country during the year 1888 were over one thousand millions of dollars. We have no reports as yet on the earnings of gas companies, electric-light companies, telephone companies, street-car lines, telegraph companies, express companies, sleeping-car companies, manufacturing corporations, standard oil monopoly, cotton-seed oil trust. They mount up into the hundreds of millions every year. The profit of trade in the agricultural products of the country alone amount to more than the total value of those products only a few decades back. In a word, the wealth has been steadily flowing away from the farms and into other forms.

This has come about in two ways: first, by the natural increase of manufacturing industry and of commerce in an age of steam and electricity, which would show relative increase of capital invested in those branches; and second, by the actual fall of late years in all farm values in the old and settled communities incident to the opening up of new fields, which are enabled to compete in the world's market by the cheapening of transportation in railway and steamship service. Not only Dakota and Montana compete in London with the Pennsylvania wheat, but also India, Russia, and even Africa. There has been a great fall of late in the value of farm staples in the world's market, which has depressed the value of farms in all the settled countries,— in England, France, and Germany, as well as in our Eastern States. There are no signs that those prices will go up again, at least in your day and mine.

Africa, South America, India, Russia, and Australia will be opened up faster than the demand for bread-stuffs will increase, and you may be sure that Europe will not pay as high prices for our surplus wheat and corn when it can get cheaper supplies elsewhere. We need expect then no recovery in farm values so far as these depend on the price of staple commodities.

In examining this question of taxation, then, let us impress upon our minds several points: first, that we cannot hope to get money where it is not, no matter how good our system may be; second, that the wealth of the country is no longer in its farms; third, that the present revenue system is based on that supposition, and that consequently our whole revenue system must be radically changed to bring it into harmony with our modern industrial conditions.

No mere tinkering or pottering around with existing taxes is going to help. We must make up our minds to go to the root of the matter at once; recognize that if we wish revenue we must reach the place where it is, and not try to get it from where it is not.

Before proposing our remedy it is desirable to glance at our present system and its effect. We have already seen that it is inadequate to meet the demands we are making and shall make upon it. It is simply impossible to get adequate revenue from it.

There is, however, another reason why our present revenue system is unsatisfactory besides the mere reason that it can not meet the heavier demands upon it, i.e., than its insufficiency to get the necessary revenue, and that is, that, owing to the great changes in our industry, it has become grossly unjust.

We may characterize the system as a whole as the general-property tax system, i.e., the effort is made to ascertain the valuation of the entire property belonging to every taxable, and then to collect a certain per cent of that valuation for the use of the public. Even if it were possible to ascertain such value, and collect the tax levied upon it, the system would be a grossly unequal one, and undesirable from many points of view. It would tax, for example, the thrifty farmer who had accumulated from his savings a sum sufficient to purchase a small farm in proportion to his thrift and savings; while it would let the extravagant lawyer or physician who makes thousands of dollars every year and lives it all up, go scot-free of all taxation. All those classes who use up their income as they go along would escape taxation, while those who save and invest it in some form of property would have to bear all the burden of taxation. It would, in a word, discourage savings and encourage waste. Such a tax makes no distinction between the people of small property and those of large means.

The true principle of taxation is not every one in proportion to his property, but every one in proportion to his ability; and ability is not measured by possession of property alone, since a man of large means may better afford to give a larger sum than a person of small means a small sum. A general-property tax, moreover, takes no account of whether the property is available for purposes of income or not. A person is taxed upon what he has, irrespective of the fact whether he can get anything out of it or not. And so I might go on and show how unequal and wasteful such a tax is, even if it could be fully assessed and collected; but the fundamental objection to it is that it can never be assessed and collected. To make it even approximately complete you must rely on the declaration of the taxable that he has given a full and true list of his property. A portion of this property can, of course, be seen, such as houses and lands and furniture, implements and tools, pictures, books, pianos, etc. But another class cannot be seen; such are stocks and bonds, notes, mortgages where owned outside of the community, etc., and all other forms of immaterial rights. It is impossible to assess these things except upon the personal declaration of the owner. Now everybody who has looked into the matter at all agrees, I believe, that this cannot be relied upon at all.

All tax commissions which have reported upon this point say that existing laws do not secure such a return. Taxables commit perjury by wholesale in such matters, and think nothing of it. How much of this sort of property escapes taxation can be seen from examining the tax books and reports of any of our leading American cities. We have, of course, no adequate statistics of the relative value of personalty and real estate for any country or part of a country. No one, however, estimates the value of the personal prop-

erty held by the inhabitants of a great city at anything less than the total value of the real estate, and it is my opinion that it is much more. According to the report of the tax commission of the State of New York in 1871, the real estate assessed in that State for the years 1869–70 was more than three and one-half times as valuable as all the personal property owned by citizens of that State. In the city of Brooklyn the valuation of real estate was over ten times as much as that of personal property, Rochester over six times, Buffalo and Albany over four times as much, In the city of New York it was nearly two and one-half times as much. One county in New York reports real estate worth seventy times as much as all the personal property owned by its citizens. Massachusetts, which has perhaps the best enforced law of this kind, does not reach over two thirds of the personal property in the opinion of its tax collectors. Connecticut misses forty per cent. One may almost say that in the large cities much the larger half of the personal property escapes taxation altogether. That means, of course, that the other forms of property are disproportionately burdened. The total personal property of the entire State of New York was returned in 1870 at $434,000,000. Why, there were at that time in the city of New York alone twenty-five individuals who together probably possessed that sum. The value of the steam railroads in that State in that year was $300,000,000. In a debate in the constitutional convention of 1867, Mr. Pierrepont of New York said that he could name thirty individuals in New York City whose combined personal property exceeded the whole assessment of the State for that year by a very large sum. The whole personal property assessment of the city of Brooklyn against private individuals for the year 1867 was less than ten million dollars. Possibly it had a single citizen who was worth that amount.

But why multiply examples. They are like sands of the sea for multitude. Now, under any such a system as this, those classes who have, comparatively speaking, little personal property are the ones who must bear the burden of taxation. Who are they? Speaking generally, the farmer in the country and the small man in the city; the laborer who has saved up money to buy him a little house, and whose whole property is, therefore, open to the assessor; the farmer who has put all his money into his farm. Who profits by it? The man of means who invests his money in railroads, bank stock, gas companies, etc.

The objection which I have been urging against the general-property tax which forms the backbone of our system would apply more or less to the system at all times; but it is becoming more and more potent as time goes on, owing to the fact above mentioned that the proportion of wealth in an immaterial form, such as stocks and bonds, is steadily increasing. I hardly need to dwell upon this point. You all know how enormously the value of railroads in this country is increasing. Nearly all of it consists of immaterial or personal property; or where it consists of real estate, the value of such real estate cannot be measured by the ordinary standards, but it possesses a value growing out of the peculiar business of the railroad which is rarely reflected as it should be in the tax books. The railroad is the most striking example, but not even is it so important as the aggregate of similar undertakings in other lines of business. Consider for a moment the stock of express companies, telegraph companies, telephone companies, gas companies, electric lighting companies, joint stock banks, manufacturing companies, etc. Indeed, the marked tendency of capital to-day is to assume the corporate form, owing, among other things, to the ease with which it escapes taxation. This is a phenomenon of comparatively recent date. The corporation first became a prominent feature of our industrial life, as of that of other countries, since 1850. There were, of course, many corporations before that date, and one or two flush periods when nearly everybody took a hand in them, but they were confined to few departments of industry. After 1850 they grew rapidly. In Germany, for example, only 54 are known to have been founded before 1850, while 1,150 have been formed since that time. In Austria there were in 1857 only 58 in all, but they had risen to 731 by 1873. England and America are, however, the classic lands for the development of corporations. In 1844 there were 119 in England, but they had increased to 2,549 in 1862, and by 1886 over 25,000 had taken out charters, though many of them had wound up their affairs, so that only 11,000 were in operation in that year, with a paid up capital of over three thousand millions of dollars.

In this country we have accurate statistics only for a few of the States, and then only in regard to certain formal facts. In Massachusetts, from 1852 to 1863, anywhere from ten to fifty companies were formed each year. The next three years averaged three times as many; then came a long period up to 1880 in which about seventy-five to one hundred were established each year, and since 1880 an enormous number have been formed, rising to 233 in 1889. The total capital of these companies aggregated upwards of $300,000,000. In the State of Ohio in 1889 over three hundred corporations for manufacturing purposes were organized, and the average for the last ten years has been over two hundred. Now all these things mean, of course, that property of the community is all the while taking on more and more the personal property form, is leaving the country for the city, and that any general-property tax system is becoming more and more unequal owing to impossibility of keeping track of it. With every passing year, then, our present system is becoming more and more untenable, and yet we are not ready to break with it.

There is still another circumstance which should be considered in this connection before leaving it, as having a special relation to the farming classes, and that is the rapidly changing proportion between town and country population. It is easier to avoid personal property taxation in the city than in the country. And thus from this reason also the burden of taxation becomes more unequal. In 1790 only three per cent of the population of the United States lived in cities of 8,000 and upwards In 1800 (using round numbers), four per cent, in 1810 five per cent, 1830 seven, 1840 nine per cent, 1850 thirteen, 1860 sixteen, 1870 twenty-one, and in 1880 twenty-three. It is not yet known exactly what the new census will show in this respect, as the population of all cities above eight thousand has not been given. But some figures have been given to show that this tendency has steadily increased. In 1880 there were twenty-four cities in the United States with 75,000 inhabitants and over, while in 1890 this number had increased to thirty-four, i.e., while ten years ago about thirteen per cent of the people of the country were living in cities of 75,000 and over, to-day over sixteen per cent are to be found in such cities. The increase of these thirty-four cities, without counting New York, has been almost forty-five per cent, while the general increase in the country as a whole has not exceeded twenty-five per cent. Reports have been also published of forty-two other cities having a population of 20,000 or over. The increase in the seventy-six cities over the population of the same cities in

1880 was about forty-eight per cent. The census may be faulty, but I take it that we shall have to admit that growth of the cities has been much more rapid than that of the country. This being so, it still further tends to increase the burdens of those classes who can least easily conceal their property under a general-property tax system, viz., the farmers.

The rapid growth of the cities, in many cases at the expense of the country, tends, moreover, to leave a continually increasing burden of expense upon the shoulders of the rural districts, which tends to overburden the latter still more.

Under our system of taxation, then, the farmer, using that term for the country districts in general, is at a disadvantage in several respects. In the first place, as we have seen, our method of obtaining public revenue by taxation touches chiefly that form of property which is visible and can not escape the eye of the tax assesssor or tax collector; while that which can be hidden, or known only by a general system of registry, such as mortgages, bonds, stocks, etc., practically escapes taxation altogether. Now the farmer has a larger proportion of his property in this form than any other class. If he is thrifty he can buy more land, put up a better class of buildings, get a better breed of stock, use better machinery, etc. Every improvement in his condition, in a word, reflects itself in something visible about the farm, and thus subjects him to heavier taxation. It is very different with the inhabitants of the cities. A wealthy man, of course, occupies as a rule a better house in a dearer neighborhood than a poor man, and to that extent pays more taxes; but as his wealth increases, his house does not necessarily grow better. His scale of living may not increase proportionately. A millionaire is quite as likely to live on as great a scale as one who has ten times the property. As a result, the visible forms of wealth do not increase as rapidly in the case of the wealthy city man as in the case of the country farmer. More and more of the property takes the form of mortgages, bank, railroad, and manufacturing stock, and bonds. All these things escape the eye of the tax assessor, and to that extent relatively lighten the burden of the wealthier classes.

(To be continued.)

## NOTES AND NEWS.

THE bacillus of tuberculosis, says *Nature*, is often to be found in places lived in by consumptives. Herr Prausnitz has lately collected the dust in various compartments of trains which often convey patients from Berlin to Meran, and inoculated a number of guinea-pigs with it. Two out of five compartments so examined were found to contain the bacillus; the dust of one rendered three out of four guinea-pigs tuberculous, that of the other, two. The animals were killed after ten to twelve weeks, but in no case was the disease very advanced; the author supposes the number of bacilli to have been but small. The facts, however, seem to point to the necessity of disinfection of such railway carriages, especially the carpets or mats.

— Under the will of Dr. Fothergill (1821), funds were bequeathed to the Society of Arts, London, for the offer of medals for subjects, in the first instance, relating to the prevention of fire. The society now offers a gold medal or £20 for the best invention having for its object the prevention or extinction of fires in theatres or other places of public amusement. In cases where the invention is in actual use, reference should be made to places where it could be inspected. A full description of the invention, accompanied by such drawings or models as are necessary for its elucidation, must be sent in on or before the 31st of December, 1891, to the secretary of the Society of Arts, John Street, Adelphi, London. The council reserve the right of withholding the prize, in case there is nothing, in their opinion, deserving the award, or sufficiently complying with the conditions sent in for competition.

— To the usual well-known ways of stimulating muscles to contraction, viz., electrical, thermal, mechanical, and chemical, M. D'Arsonval has recently added that by means of light (*Nature*, Aug. 20). He could not, indeed, get any contraction in a fresh frog-muscle, when he suddenly threw bright light on it in a dark chamber; but having first in darkness stimulated a muscle with induction currents too weak to give a visible effect, and then suddenly illuminated the muscle with an arc light, the muscle showed slight tremulation. Not thinking this conclusive, however, M. D'Arsonval attached a muscle to the middle of a piece of skin stretched on a funnel, and connected the tube of the funnel, by means of a piece of india-rubber tube, with the ear. The muscle being now subjected to intense intermittent light, he heard a tone corresponding to the period of illumination, and this ceased when the muscle was killed with heat. Arc light was used, which was concentrated by a lens and passed through an alum-solution to stop the heat rays.

— From a recent issue of *Nature* we learn that M. Raspail has lately called attention in the Zoölogical Society of France to the serious diminution of birds in that country through destruction of their nests. Some insectivorous species are becoming very rare, while the ravages of parasites on useful plants are extending. Boys, of course, do a great deal of the mischief; and of the various animals which attack nests (the squirrel, the hedgehog, the dormouse, the magpie, etc.), M. Raspail regards the cat as the worst offender. On a recently wooded property of about seven acres he observed last year as follows: Out of thirty-seven nests, carefully watched, only eight succeeded; twenty-nine were destroyed, fourteen of these by the cat, though effort had been made to ward off this insatiable marauder. On a large property in the centre of a village the owner had about eighty cats annually caught in traps. The place having lately changed hands, the gardeners estimate that more than one hundred nests were destroyed last year, three-fourths of these by cats. M. Raspail advocates a rigorous application of the law for protection of insectivorous species, the disqualification of the cat as a domestic animal, and the giving of prizes to foresters and others for destruction of all animals which prey on eggs and young in the nest.

— Tobacco fermentation, a very essential process, is brought about by firmly packing ripe tobacco in large quantities. *Nature* states that it had been generally supposed that the fermentation is of purely chemical nature, but Herr Suchsland, of the German Botanical Society, finds that a fungus is concerned in it. In all the tobaccos he examined, he found large quantities of fungi, though of only two or three species. Bacteriaceæ were predominant, but Coccaceæ also occurred. When they were taken and increased by pure cultivation, and added to other kinds of tobacco, they produced changes of taste and smell which recalled those of their original nutritive base. In cultivation of tobacco in Germany it has been sought to get a good quality, chiefly by ground cultivation and introduction of the best kinds of tobacco. But it is pointed out that failure of the best success may be due to the fact that the more active fermenting fungi of the original country are not brought with the seeds, and the ferments here cannot give such good results. Experiments made with a view to improvement on the lines suggested have apparently proved successful.

— Experiments in various methods of seeding wheat have been conducted for a series of years at the Ohio Experiment Station, with the following results: In the average of four years' experiments, wheat covered one inch or less has produced at the rate of thirty-four bushels per acre, that covered two inches has produced thirty-five bushels, and that covered three inches thirty-four bushels. Judging from a smaller number of experiments it does not seem advisable to sow deeper than three inches. In the average of six years, wheat sown with the roller-press drill has yielded about eight per cent more than that sown with the ordinary drill. More or less increase has followed the roller-press in almost every season, but a single trial has given results unfavorable to the use of the common roller after seeding. Broadcast wheat has this year yielded about the same as that drilled; but in

the average of five years the produce from broadcast seed is considerably smaller than from the same quantity of seed drilled. The results of seven years' experiments point clearly to the latter part of September or first of October as the most favorable season for sowing wheat on this farm. A single experiment, made this year, fails to show any advantage in favor of cross drilling over sowing the same quantity of seed in the ordinary manner. No larger crop has been produced this year from mixed seed of two varieties than from pure seed of the same varieties sown separately. The land upon which these experiments were made lies in the valley of the Olentangy, one of the largest branches of the Scioto. The soil is a yellow loam, part first and part second bottom. It is either naturally underdrained with gravel or artificially drained with tiles, and its average yield of wheat for thirteen years has been over twenty-six bushels per acre, on an annual acreage of about thirty acres.

— The laughing plant is the name of a plant growing in Arabia, and, according to the *Medical Times*, is so called by reason of the effect produced upon those who eat its seeds The plant is of moderate size, with bright yellow flowers, and soft, velvety seed-pods, each of which contains two or three seeds resembling black beans. The natives of the district where the plant grows dry these seeds and reduce them to powder. A dose of this powder has similar effects to those arising from the inhalation of laughing-gas. It causes the most sober person to dance, shout, and laugh with the boisterous excitement of a madman, and to rush about cutting the most ridiculous capers for about an hour. At the expiration of this time exhaustion sets in, and the excited person falls asleep, to awake after several hours with no recollection of his antics.

— The following persons will be the officers of the American Association for the Advancement of Science for the ensuing year: President, Professor Joseph Le Conte of the University of California; vice-presidents, Section A, Professor J. H. Eastman, Naval Observatory, Washington; B, Professor B. F. Thomas, State University, Columbus, O.; C, Dr. Alfred Springer, Cincinnati; D, Professor John D. Johnson, Washington University, St. Louis; E, Professor H. S. Williams of Cornell; F, Professor S. P. Gage of Cornell; H, W. H. Holmes of Washington; I, S. Dana Horton, Pomeroy, Ohio; permanent secretary, F. W. Putnam of Harvard University; general secretary, Amos W. Butler, Brookville, Ind.; secretary of the councils, Professor T. H. Norton, Cincinnati; secretaries of sections: A, Professor W. Upton of Brown University; B, Professor Brown Ayers, Tulane University, New Orleans; C, Professor J. L. Howe, Polytechnic Institute, Louisville; D, Professor H. Landuth of Vanderbilt University, Tenn.; E, Professor R. D. Salisbury, State University, Madison, Wis.; F, Professor L. B. D. Halstead, Rutgers College; H, Mr. Colin of Philadelphia; I, Professor Lester Ward of the Geological Survey, Washington; treasurer, William Lilly, Mauch Chunk, Penn.; auditors, Dr. H. Wheatland, Salem, Mass , and Professor Mehan, Germantown, Penn. The next meeting of the association will be held in August, 1892, at Rochester, N.Y.

— A meeting was held in Washington, on Aug. 28, at the Columbian University, which promises to result in the formation of one of the most valuable organizations in the country for the advancement of geological work, and especially of official geological work. This is an official organization of the directors of the state and national geological surveys. There were present at the meeting Maj. J. W. Powell, director of the United States geological survey; Professor James Hall, State geologist of New York: Professor J. M. Safford, State geologist of Tennessee; Professor J. W. Spencer, State geologist of Georgia; Professor E. A. Smith, State geologist of Alabama; Professor J. A. Holmes, State geologist of North Carolina; Mr. Arthur Winslow, State geologist of Missouri; Mr. E. T. Dumble, State geologist of Texas; and Professor J. Lindahl, State geologist of Illinois. Maj. Powell was elected chairman of the meeting and Mr. Winslow was elected secretary. After a few preliminary remarks in explanation of the reasons for calling the meeting, Mr. Winslow read a paper suggesting a plan of organization and explaining the objects of and the results to be derived from such an official association. As prominent among the important objects of the associatton the following may be cited: (1) the determination of the proper objects of public geological work; (2) the improvement of methods; (3) the unification of methods; (4) the establishment of the proper relative spheres and functions of national and state surveys; (5) co-operation in works of common interest, and the prevention of duplication of work; (6) The elevation of the standard of public geologic work, and the sustenance of an appreciation of its value; (7) the inauguration of surveys by States not having such at present, to co-operate with the other State surveys and with the national survey. As an immediate result of this meeting a committee of six was elected to consider the matter of organization, with the power to frame a constitution and by-laws, to be reported to the association at a time and place to be selected by the committee. This committee consists of Maj. J. W. Powell, chairman; Professor E. A. Smith, Professor J. A. Homes, Dr. J. C. Branner, Mr. Arthur Winslow, and Professor W. H. Winchell. It is a matter of sincere congratulation that the association, whose organization has been an oft-mooted question, is now in a fair condition to become an established fact. That it will serve as an invaluable agent in securing harmony and efficiency in the important public work will be readily appreciated.

— Snow-drifts are found a serious disturbance of the Russian railway system. With a view to forecasting such occurrences, according to *Nature*, M. Sresnewskij has lately collected information about snow-drifts on the Russian lines during 1879–89 (*Rep. für Met.*). The drifts occur in the northern and eastern governments, chiefly with south-west wind, but in southern Russia with north east. In the north greater gradiants are required than in the south. The maximum of the drifting is in mid-winter, but there is more in the second half of winter than in the first, that having more snow. In the course of winter the snow grows in thickness, so that in March there is more to drift than in December. The marked diminution of drifting in February is due to the less wind in that month (a fact not yet explained, as the number of cyclones shows no decrease). Two kinds of drifting are distinguished; it may be only or chiefly snow lying on the ground that is whirled and carried along, or the wind may drive falling snow. There are most drifts in the months that have least snowfall and the smallest number of days of snow. The snow-drifts in South Russia with north-east wind are chiefly connected with anticyclones in the central region, or cyclones on the southern border; those in the east and north with cyclones in European Russia. In central Russia they occur with cyclonic winds of various direction, seldom with anticyclones.

— An investigation (more comprehensive than the previous ones by Forel, Fritz, and others) of the variations of Alpine glaciers has been recently made by Herr Richter of the German and Austrian Alpine Club. To six advances of glaciers, previously known, he adds three, and his account of the six differs somewhat from previous ones. The dates of commencement of the nine advances are 1592, 1630, 1675, 1712, 1735, 1767, 1814, 1835, 1875 (?). The following are some of Richter's conclusions, as given in *Nature* of Aug. 20: Glacier advances recur in periods varying between twenty and forty-five years; on the average of three centuries, thirty-five years. The advances are not all of equal intensity, nor alike in their progress. Nor is the intensity in a given advance-period the same in all glaciers. In the case of some glaciers, a period is occasionally skipped, the advance or retirement being very weak, so that the thirty-five years period gives place to one of seventy years. The glacier variations correspond, in general, with Brückner's climate variations. The glacier advance generally begins a few years after the moist and cool period has set in. There is no good reason to suppose that, in historic time, before the sixteenth century, the Alpine glaciers were smaller than now, or that variations occurred of a different order and period from those of the last three hundred years. About 1880 the earth was passing through a moist and cold period, which should have resulted in a general advance; but the advance has been but slight hitherto, and, in the eastern Alps, mostly absent. The cause of this is not at present clear, but the mild nature of this last cold period may have something to do with it.

# SCIENCE:

*A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES*

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.


## THE SELF-PURIFICATION OF RIVERS.[1]

WE have evidently placed too much confidence in the innate power of rivers to throw off the evil effects of pollution by sewage, which power we now see is largely imaginary. On the other hand, we find, if we may believe the authorities, some comfort in the fact that the bogy of the present day, the microbe, has not that miraculous vitality which popular belief has attributed to it, and is even to be disposed of by so commonplace a matter as sedimentation. Dr. Frankland in the course of his paper refers more than once to the remarkable powers of self-purification of the Thames. That our metropolitan river must practise this virtue to a prominent degree is manifest from the cruel ill-usage to which we subject it; but we gather that the author referred chiefly to the up-country reaches. Below bridge, especially in the neighborhood of Barking and Erith reaches, no self-purification could compensate for the filthy flood that is daily discharged at Crossness. There have been reports of various highly paid experts from time to time, the reading of which would lead one to suppose that there was nothing, or little, to be desired in regard to the state of the water in this region. But those who live near the banks, or whose duty takes them down the river, know how misleading these reports are. At low water especially, the banks are formed by reeking flats of sewage deposit, and when a steamer passes along and churns up the filthy sediment the stench is of a most sickening description.

To return, however, to Dr. Frankland's paper, which says nothing about the unsavory reaches below bridge, the author commences by saying that the subject of the self-purification of rivers admits of being considered from two perfectly distinct points of view, viz., from the chemical and from the biological aspects. Until recently the subject has only been discussed from the chemical point of view. The firm conviction possessed by many that rivers undergo spontaneous purification in the course of their flow is generally based upon personal observations made upon streams in which the process appears to be going on in such a striking manner that no analytical evidence is required. All engineers are acquainted with streams which are visibly polluted at one spot, and apparently pure a few miles lower down. When such cases are further submitted to analytical tests, the latter, of course, fully confirm the previous ocular impressions. In fact, such disappearance of organic matter does take place, but when these cases of supposed self-purification are carefully investigated, it becomes very doubtful whether the phenomenon is due to anything beyond dilution and sedimentation. The careful experiments which have been made to test this point are by no means numerous. A series of investigations was made by the Rivers Pollution Commissioners of 1868 to test the point, both as regards highly polluted streams and comparatively pure ones, but in both cases their results were of a negative character, and pointed to no real purifications, i.e., destruction of organic matter, although there was distinct evidence of considerable improvement in the quality of the water through sedimentation.

Some years ago Dr. Frankland undertook a series of experiments to further test this point in connection with the Thames, which has always been regarded by some as a river possessed of most remarkable self-purifying power, and which undoubtedly often does reach London after a long flow through a cultivated and fairly populated district in a surprisingly pure state. The experiments in question consisted in taking samples of the water flowing in the river at different points on the same day, with a view to establishing whether on the whole the chemical quality of the water was improved or deteriorated during the course of its long flow. Thus, on one day, samples were taken at Oxford, Reading, Windsor, and Hampton; on another day at Chertsey and at Hampton; and on three different occasions samples were collected both at Windsor and at Hampton on the same day. The results of analysis of these various samples are recorded in a table accompanying the paper. They clearly indicate that the chemical quality of the water undergoes slight but almost continuous deterioration in flowing from Oxford to Hampton. This deterioration is in spite of a very large increase in the volume of the water, a large proportion of which gains access to the river from springs in the chalk, and is of the very highest purity. Thus, Mr. Thornhill Harrison, C.E., has determined that the total increase in volume in the Thames between Maidenhead and Thames Ditton was (exclusive of the Colne, Wey, and Mole) in April, 1884, 249,500,000 gallons per day; on July 8, 1883, 49,000,000 gallons; July 22 to 26, 131,000,000; November, 1890, 45,000,000.

After quoting several columns of figures contained in tables, unfortunately too voluminous for us to reproduce, the author goes on to point out that by their study and that of the most recent investigations, we are led to the inevitable conclusion that sedimentation is the main cause of any self-purification in river water. Of any oxidation of dissolved organic matter there is still no reliable evidence, although of course dilution, which frequently takes place on the largest scale, as in the case of the Thames, without being suspected until made the subject of a most careful scrutiny, will produce a superficial appearance of such a result. This removal of microbes by sedimentation during the flow of a river is unquestionably of great hygienic importance, and of much greater hygienic importance than the alleged oxidation of dissolved organic matter, which in itself can have no power of communicating zymotic disease. It is, however, a process which cannot be relied upon as furnishing any guarantee that harmful microbes, turned into a stream at a given point, will no longer be present in the water at any point lower down. From the numerous experiments which have been made on the vitality of pathogenic microbes in water, there can be no doubt that many forms which might have subsided, would remain alive for long periods of time, and be carried down uninjured when the river was next in flood. Dr. Frankland concludes his paper by saying that we must not allow sedimentation of microbes to cause us to relax our protective measures to exclude contamination from our streams, but on the contrary, bacteriological research clearly indicates, on the one hand, the value and importance of purifying by the very best available means all dangerous liquids, such as sewage, before admission into rivers; and, on the other hand, to submit the water drawn from streams for town supply to the most careful subsidence and filtration through sand before delivery.

[1] Abstract of a paper by Dr. Frankland, read before the Health Congress, London, Aug. 17 (reported in Engineering).

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THE Summer School of Ethics and Sociology at Plymouth, Mass., the first session of which has just been held, is described in a brief illustrated article in the *Review of Reviews* for September. The article is illustrated with portraits of Professor Felix Adler of New York, Professor Toy of Harvard, and Professor Henry C. Adams of Ann Arbor.

## LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

*On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.*

*The editor will be glad to publish any queries consonant with the character of the journal.*

### A Suggestion to Rain-Makers.

WHILE these interesting and expensive attempts to produce rain by explosions are being carried out, it should be of special interest to science to ascertain what would be their effect when the general conditions of the atmosphere are favorable for rainfall. The promoters of these experiments show certainly great faith in their theory by selecting the worst imaginable conditions of the arid west for their playing ground; and though faith is an excellent thing, which is said to be even capable of moving mountains, and though Moses, when he was brimful of faith, produced water by striking a rock in the desert, still I am afraid these experiments may have taxed their theory too heavily by venturing to produce rain under the dry conditions generally prevailing in Texas.

Among the absolutely necessary conditions for rainfall is this, that the surface-air should not be dry; and whatever the effect of explosions may be at a higher level, the rain-drops cannot reach the ground by passing through dry surface-air, and it is not conceivable how explosions could suddenly change the dry surface-air into moist or saturated air.

But while these expensive experiments are being gone through, it might be of special interest to ascertain what would be the effect of explosions during a natural rain, or immediately after a natural rain has ceased; and I venture to predict that in the first case the concussion might give a sudden impetus to the downpour, and in the latter case likely produce an after-shower of short duration; and these results would be confirmatory of some experiments whereby I have ascertained that condensation is procurable by compression of saturated air.

A flash of lightning has often been observed to be followed by a sudden increase of downpour in its immediate neighborhood, and although this is likely due to electrical rather than mechanical causes, still I feel confident that a compression-wave passing through saturated air would result in similar effects; and whether this is actually the fact ought therefore to be ascertained while the means of doing so are at hand and while the general interest is awakened on the subject, — if I may venture to make this suggestion.

FRANZ A. VELSCHOW.

Brooklyn, Aug. 31.

## BOOK-REVIEWS.

*A Treatise upon Wire, its Manufacture and Uses.* By J. BUCKNALL SMITH. New York, Wiley. 4°. $3.

So far as we know, there is no other treatise upon wire which covers so much of the history and uses of the material as the one before us. The manufacture of gold wire dates back at least to 1700 B.C. The present method of drawing wire has been practised certainly in the fourteenth century in some portions of Germany. From these early beginnings our author traces the history of wire and its uses. It was not till 1565 that machine-drawn wire of home make was available in England for the making of hair-pins for Queen Elizabeth; but by 1630 the home industry had grown to such importance as to lead to the total prohibition, by Charles I., of the importation into England of foreign wire.

The uses of wire are, of course, many, and to each our author gives attention in turn. There are the electrical applications, which call for consideration of the tensile strength of the material and its conductivity; there are its uses in netting, gauze, cloth, and cards; there are the pin-making industry and the manufacture of needles; the making of umbrella and spectacle frames, of springs, cycle spokes, nails, and music strings, each of which makes it necessary to produce a wire having properties which shall suit it to the special use. The first chapter treats of iron and steel wire, the latter of which has been brought to a high degree of tensile strength, with the resulting possibility of cable-roads and improved means of transportation on wire-rope railways.

The second chapter is devoted to copper, bronze, brass, platinum, and gold wire. This leads to the consideration of very fine wires and the question of measurement and gauging, to which last subject the third chapter is given up. The fourth chapter, on electrical conductors, closes the first section of the book, which is more especially on the manufacture of wire.

The second section of the book covers the application of wire in ropes, netting, woven fabrics, fencing materials, staples, nails, etc.

The number of illustrations is large and of a character to greatly increase the value of the book.

## AMONG THE PUBLISHERS.

AT the beginning of October an increase of 33⅓ per cent will be made in the amount of reading-matter printed in the New York *Critic*.

— "An introduction to the Study of Petrology: the Igneous Rocks," by Frederick H. Hatch, has recently been published by Macmillan. This is a descriptive work of small size. The author does not give any attention to the methods of examining rock sections, etc., but aims to describe the mineral constituents and internal structures of the igneous rocks, their mode of occurrence, and their origin.

— John Wiley & Sons, New York, have issued a third edition of Ludlow's "Elements of Trigonometry." The author is Lieut. Henry H. Ludlow, U.S.A., who had the co-operation of Edgar W. Bass, professor of mathematics at West Point. The requirements of the United States Military Academy determined the extent and detail of treatment. The book contains both plane and spherical trigonometry, and tables of logarithms of numbers and the trigonometric functions.

— Messrs. Longmans, Green, & Co. brought out not long ago a book by W. Hewitt, science demonstrator for the Liverpool school board, entitled "Elementary Science Lessons," which aims to carry instruction in science into lower grades of school work than any thing we remember to have seen. The first experiments are made with a sheet of window-glass, a burning candle, and a glass bottle or tumbler, which pieces of apparatus are made to serve many a useful purpose in bringing home physical truths to the infant minds during the course laid out by the author. Yet we often question the wisdom of teaching a child in the class that glass is smooth.

— The American Academy of Political and Social Science has recently published a monograph on "Recent Constitution Making in the United States," by Francis Newton Thorpe, Professor of Constitutional History in the University of Pennsylvania. The paper is a review of the work accomplished by the Constitutional Conventions of North Dakota, South Dakota, Montana, and Washington. The academy has also recently published a paper on the development of economic science in Italy, by Achille Loria, who is Professor of Political Economy and Statistics in the University of Siena.

— The Rural Publishing Company, New York, has recently brought out "The Nursery Book," which is a guide to the multiplication and pollination of plants. The author is Professor L. H. Bailey of the Cornell Agricultural Experiment Station at Ithaca, N.Y. A nursery is, by Americans at any rate, understood to mean a place where woody plants only are cultivated; but our author designates by the word an establishment for the propagation of all plants. The book aims to give an account of the methods commonly employed in the propagation and crossing of plants; of the ultimate results and influences of these methods no account is taken. The free use of competent criticism by experienced propagators was resorted to by the author while writing the book, and it is believed that all the methods described have met with approval in this country. More than half the volume is occupied by a "nursery list," which is descriptive, and covers all the plants ordinarily grown by horticulturists in this country for food or ornament.

— "The Physical Diagnosis of the Diseases of the Heart and Lungs, and Thoracic Aneurism," by D. M. Cammann, M.D., has recently been published by G. P. Putnam's Sons, New York. This book is the result of notes thrown together for use in teach-

ing. While it is intended as a text-book on the physical diagnosis of diseases of the heart and lungs, the author has confessedly given prominence in this book to some questions which especially interested him. The author's modification of the Cammann stethoscope and the binaural hydrophone are carefully described. The averages of the measurements of the heart by auscultatory percussion are from tables made by the author's father, the late Dr. G. P. Cammann, and have heretofore been published only in part.

— D. Appleton & Co. will publish shortly a revised edition of Professor Joseph Le Conte's "Evolution and Its Relation to Religious Thought." First issued about three years ago, this work has already had four editions, and has proved to be one of the most satisfactory of the many discussions tending to establish the consistency of fundamental religious beliefs with the known laws of development. Three new chapters are incorporated, one of them relating to matters upon which the author states his mind was not fully clear when the book was first written, and he has been "willing to wait and let the leaven work."

— "First Lessons in Arithmetic," of Appletons' Standard Arithmetics, by Andrew J. Rickoff, A.M., LL.D., has just been issued by the American Book Company. In the first steps all the exercises and problems given involve numbers not greater than ten, a modification of the Grube method being employed. Illustrations and diagrams are introduced with a view of making the first steps concrete with every number studied. Part II. deals with units and tens, and here the method, so far as applicable, is the same as that pursued with the digits; and so on. In all parts of the book a proper balance is maintained between two much explanation and too little. A large number and variety of exercises and appropriate problems are provided, and needed explanations and illustrations are given.

— Several new leaflets have just been added to the general series of "Old South Leaflets," issued by the directors of the Old South studies in history, and furnished by D. C. Heath & Co., Boston. All of them are connected with the English Puritan period, and are of value in the study of the development of our own political liberty and of our political system. They include the "Petition of Right," presented by Parliament to King Charles in 1628; the "Grand Remonstrance;" the "Solemn League and Covenant," which gave the name of "Covenanters" to the Scottish Protestants; the "Agreement of the People;" the "Instrument of Government," under which Cromwell began his government; and "Cromwell's First Speech to his Parliament." These "Old South Leaflets," furnishing these famous original documents, heretofore almost inaccessible to the mass of the people, for the few cents covering their cost, are invaluable. There are now nearly thirty in this general series.

— "The Modern Antipyretics: their Action in Health and Disease," by Isaac Ott, M.D., has recently been published by E. D. Vogel, Easton, Pa. The process of fever is more studied of late than ever, and the number of antipyretics has been considerably increased. The maintenance of a constant temperature in the human body is due to the rate of loss of heat being equal to that at which it is generated. The ordinary theory is that in the case of fevers the rate of generation of heat is increased. While this is primarily true, i.e., the fever state is set up by an increase of the rate of heat generation, it is now maintained by a respectable minority that fever is not due to a fire which is kept up by an unduly rapid oxidation of the constituents of the body, but that the increase in temperature is due to a disturbed condition of the means of the dissipation at the surface of the body of the heat generated within. Dr. Ott attacks the two free use of most antipyretics, and recommends the application of such means as will allow the internal heat to escape, as it were.

— Messrs. Macmillan & Co. have commenced the publication of a "Dictionary of Political Economy," which bids fair to be a work of real importance. The first part, containing 128 pages, extends as far as the word "bede," the volume being an octavo with two columns on a page. The editor is Mr. R. H. Inglis Palgrave, and the writers in this first part comprise a large number of the best qualified men in England and Scotland, with several in America and continental Europe. The articles are intended to cover not only every important topic in economic science, but also many legal and political subjects which it is necessary for economists to know about. Brief biographies of economic writers are given, with some notice even of men like Aquinas, who have treated economics only incidentally. The topic accorded most space in this part is banking; but almost every subject having an economic bearing is dealt with at greater or less length. Judging by this number alone, we should say that the theoretical topics were in danger of being insufficiently treated; but this may be remedied in future numbers. The work is to be completed in twelve or fourteen parts, issued at intervals of about three months, at one dollar each.

— Messrs. S. C. Griggs & Co. announce for early publication "A Study of Greek Philosophy," by Ellen M. Mitchell, with an introduction by W. R. Alger. The author endeavors to explain what is meant by philosophy, discussing the character and source of the Greek philosophy, showing whence came the beginnings of Greek religion and culture. The earlier schools of thought, including the Pythagorean, the Eleatic, the Atomistic, and others leading up to the school of the Sophists, receive critical treatment, short biographical sketches of their principal exponents being given. The chapters on Socrates and the Socratic philosophy are unusually full, the life, character, and fate of the great philosopher being told; and Platonic and Aristotelean philosophies are explained.

— Messrs. William Blackwood & Sons have published a pamphlet by Professor James Seth on "Freedom as Ethical Postulate," which may interest some of our metaphysical readers. The writer by no means agrees with thinkers like Professor Paulsen that the question of free will belongs to the region of metaphysical antiquities: on the contrary, he holds that its solution is necessary to the establishment of a true moral philosophy. He rejects the theory of determinism, and also that of Kant, with its distinction of noumenon and phenomenon, though he agrees with Kant in thinking that our moral consciousness gives us immediate evidence of freedom. The question, then, is how to reconcile this consciousness of freedom and responsibility with the law of causation; but in attempting this task we cannot think that Professor Seth is much more successful than other thinkers who had preceded him. His essay, however, contains some useful hints, and sets forth the present state of the problem very clearly in a small space.

— The *Century Magazine* will celebrate the 400th anniversary of the discovery of America by publishing a "Life of Columbus" written especially for that magazine by Emilio Castelar, the Spanish orator, statesman, and author. The work is written in Spanish, and will be carefully translated. Señor Castelar, whose interest in and admiration for America are well known, has made a careful study of the new historical material bearing upon the subject, and it is said that his papers will be very richly illustrated. Other articles dealing with the discovery of America are in course of preparation for the magazine. In view of the present timeliness of the subject, the same magazine has arranged to print during the coming year an important series of articles on the general subject of agriculture and the Government's relation to the farmer. Among the topics to be treated are "Agricultural Possibilities of the United States," "The Farmer's Discontent," "What the Government is doing for the Farmer," etc. Mr. J. R. Dodge, statistician of the Agricultural Department, Mr. A. W. Harris, of the same department, Professor Brewer of Yale, and others, are among the writers.

— "Optical Projection," by Lewis Wright, was recently published by Longmans, Green, & Co., New York. The author is well known by his excellent treatise on "Light." When a boy Mr. Wright was presented with a projecting lantern of considerable pretensions, a circumstance which resulted in optical projection being a hobby with him for most of the time since. Slides were formerly all that could be used, but as time went on our author found pleasure in projecting on the screen the progress of actual experiments. The beautiful phenomena of polarized light also interested him, and the making of them more spectacularly imposing had due attention. The author was intimately asso-

ciated with one of the leading opticians of London, and having every facility and a great love for the work, has added much to this fascinating method of making lectures attractive. It should be stated that the experiments are most of them physical or chemical.

— Under the auspices of the Boston Society of Natural History, there has been issued a series of "Guides for Science Teaching." No. VIII., entitled "Insecta," is by Alpheus Hyatt and J. M. Arms. This guide is intended to be a series of replies to questions which have arisen in the minds of its authors while teaching. The book is well illustrated, and may prove useful to those for whom it is intended, — teachers and not students. There is something confusing about the arrangement of the book, even repelling, but that conscientious work was put into its compiling no one can doubt. The publishers are Heath & Co., Boston.

— "Telephones: their Construction and Fitting," by F. C. Allsop, just published by E. & F. N. Spon, New York, is a thoroughly practical book. It has to do with wires, magnets, and the various parts of microphones and telephones, so that he that reads may put the parts of a telephone line together properly, and may find the cause of and remedy the various faults which so often occur. The book is especially intended for the use of such persons as wish to go into the construction of private telephone lines.

— The introduction into the high schools of a more careful study of physics, in consequence of the advancing requirements of the college entrance examinations and the increasing importance of this branch of science, has led to the writing of a number of modern text-books, among which those by Dr. Alfred P. Gage are favorably known. The "Physical Laboratory Manual and Note Book" (Boston, Ginn & Co.) aims to give just those details which the pupil should observe, unencumbered so far as possible with matter pertaining only to the construction of the apparatus. The book is not a guide to the construction of apparatus, which subject is treated in "Physical Technics" by the same author.

— F. A. Davis, Philadelphia, has published a second edition of the "Text-book of Hygiene," by George H. Rohé, M.D. Dr. Rohé is connected with the College of Physicians and Surgeons, Baltimore, and is well known among scientific men. Air and water naturally come in for first consideration in this book. Under air is considered not solely the effect of any impurities that may be contained in it, but also what influences, good or bad, are involved in changes of the atmospheric pressure, temperature, and humidity. In this connection the author is able to show the worthlessness of a superstition of surgeons that it is best to perform operations when the barometer is rising. The diagrams showing the variability of the fatality of certain diseases with the season are especially interesting. The moderation of the author throughout is pleasing, and is likely to lead to his book having even greater influence in the future than in the past. After air and water, foods are discussed. The use of alcoholic beverages our author discourages, though he appreciates their use under some circumstances, and is sufficiently scientific to comprehend the facts so far as known. Alcohol is a true respiratory food, not that it contributes nutritive material to the body, but it saves that which is stored up for other uses, by furnishing easily oxidizable material for carrying on the respiratory process and supplying animal heat. Chapters are devoted to the soil, sewerage, and the construction of habitations respectively, at least in the last case so far as any thing about them has an effect on the physical well-being of their inmates. The school-house is next considered, and due attention is paid to the effect on the health of school children of the air they breathe, the light they read by, and the positions they assume at their desks. The soldier's health, that of the prisoner and the factory operative, each have consideration. The maintenance of good health through indulging in due exercise and in cleanly habits, and the use of well ordered clothing, are subjects treated before our author touches on the disposal of the dead and the modern theories of contagion and infection. There are chapters on naval hygiene, by Medical Director Albert L. Gihon, U. S. N., and on quarantine, by Surgeon Walter Wyman, U. S. M.-H. S..

— The closing volume (III.) of the fourth edition of Chambers's "Handbook of Descriptive and Practical Astronomy," which has been issued during the past year or two by the Clarenden Press (New York, Macmillan), is on "The Starry Heavens." It might, perhaps, be said that the whole work is on the starry heavens, but while the other volumes are devoted to the means and methods of astronomical work, this volume describes what can be seen in the heavens, in contradistinction to how to see it. Perhaps the pole-star is that most familiar to most persons, at least the one to which more persons can give a name than to any other; so starting from this the author passes on to tell how the pole-star has not always been the same, and of its possible recognition by the ancient Egyptians. The classification of stars according to magnitude is described, the results of determinations of stellar parallax, and the consequent distances of a few fixed stars, the modes of designating stars, their proper motion, and the distribution of stars in space, are among the subjects treated in the early part of the volume. Several chapters are devoted to multiple and variable stars and to clusters and nebulæ, giving in each case some account of their discovery and of the problems to which their existence has given rise. The Milky Way and the constellations are treated in two chapters. The main portion of the book is taken up with the valuable catalogues of stars which make it so useful to all astronomers, and, since their needs have been specially considered, to the many amateur astronomers, possessors of telescopes of low power. Additional objects have been described as types in connection with the chapters on clusters and nebulæ. Most important new features are the photometric catalogue of naked-eye stars and the descriptions of ways of finding the constellations during the different months of the year.

— *The Political Science Quarterly* for September is equally strong on the American and the foreign side. Frederic Bancroft of the United States State Department describes "The Final Attempts at Compromise" during the winter of 1860–61. He shows that none of the proposed solutions of the slavery question could possibly satisfy even the more moderate representatives of both sections, and that none of the proposed compromises could have settled the question between the free and the slave States. Thomas L. Greene discusses "Railroad Stock-Watering" and railroad rates. He maintains that high dividends are not usually associated with high rates, and that the increase of the capital stock of a railroad is no sufficient ground for governmental interference to reduce rates. He distinguishes between innocent stock-watering, which seeks to bring railroad capitalization into accord with the laws of finance, and that which is not innocent. The latter, he thinks, can best be checked by enforced publicity, as is done in New York. Professor F. J. Goodnow of Columbia College traces the development of "The Writ of Certiorari" in England and the United States. He shows how the province of the writ has been modified and its application extended until it has become the chief means of protecting private rights against the arbitrary action of administrative authorities, the ordinary courts assuming that control over the administration which on the continent of Europe is vested in special tribunals. Three articles deal with foreign questions. Professor Richard Hudson of the University of Michigan takes "The Formation of the North German Confederation" as the text for an acute and suggestive criticism of all the legal theories regarding the federal state. He demonstrates that the formation of such a state is not susceptible of juristic explanation. Professor Ugo Rabbeno of Bologna, one of the best of Italy's younger economists, gives an extended *résumé* of "The Present Condition of Political Economy in Italy." This article contains a mass of information not elsewhere accessible, and will therefore be invaluable to all students of economic science. Finally Professor W. J. Ashley of Toronto University, Canada, subjects Gen. Booth's scheme for the social regeneration of England through Salvation Army "colonies" to a destructive scientific criticism. The "Reviews" and "Book Notes" contain about forty titles.

— John R. Spears, the author of a recent article on the devastating sand-waves at Capes Henlopen and Hatteras, has made a reputation as a traveller in out-of-the-way places. An article by Mr. Spears on "Odd American Homes" in the September number of

*Scribner's Magazine* is the result of extended observation, especially in the West and South-west, where Mr. Spears made a journey at the time of the Oklahoma boomer excitement. It is illustrated from photographs made by the auther of some very unique frontier dwellings. There has been a great deal of discussion during late years in regard to shortening college courses, and higher university work. Professor Josiah Royce of Harvard, in an article in the same number on "Present Ideals of American University Life," makes a plea for the raising rather than lowering of the university standard, and sets forth the past and present college methods, showing the lines on which he thinks the great American university of the future should work. In the same issue of the magazine Mr. James Ricalton, writing of the wonderful old ruins of monuments and shrines at Anuradhapura, the City of the Sacred Bo-Tree in Ceylon, says: "From the days of the mound builders down to the Eiffel tower, man has shown himself to be a monument-erecting being; the Christians have their cathedrals, the Mohammedans have their mosques, and the Buddhists have their shrine-tombs, designated differently in different countries as pagoda, tope, and dagoba. The pagodas of China are entirely dissimilar to those of Burmah, and the dagobas of Ceylon are quite unlike those in either country; yet all serve the one purpose of relic sepulture. They are not altogether a thing of the past; they are still erected near the temples; but those of modern construction are small and unimportant when compared with those that have withstood biennial monsoons for two thousand years; even their half-buried ruins are stupendous."

— It will be remembered that the edition of "Catalogue of Minerals and Synonyms," by Thomas Egleston, Ph.D., which was originally published by the government, was soon exhausted, and that a new edition was promised by John Wiley & Sons, New York, some months since if sufficient subscriptions should be received to justify the expense. This new edition is now received. This catalogue was commenced in 1867 for use in arranging the collections of the School of Mines of Columbia College, but the press of other duties caused such delays that practically a new catalogue was begun and finished twenty years later; and it is this that is given to the public. The need of a collection of synonyms has been shown by the quick way in which the government edition was seized upon, and we doubt not the New York publishers will be duly rewarded for bringing out this new edition ($2.50).

— In Stewart's "Plane and Solid Geometry," just published by the American Book Company, there are several features worthy of notice. One prominent feature is the close adherence to the principle of association, each book treating of only one subject, and each section of one subdivision of the subject. Another good feature is the system of so grading the exercises and presenting them in such order that their successive solution should tend to

Publications received at Editor's Office, Aug. 5-Sept. 1.

ANDERSON, E. L. The Universality of Man's Appearance, and Primitive Man. Edinburgh, Douglas (Cincinnati, Clarke). 28 p. 8°. 25 cents.
DOWIE, M. M. A Girl in the Karpathians. New York, Cassell. 301 p. 12°. $1.50.
EGLESTON, T. Catalogue of Minerals and Synonyms. New York, Wiley. 378 p. 4°. $2 50.
LANGLEY, S. P. Experiments in Aerodynamics. Washington, Smithsonian Inst. 115 p. f°.
RICKOFF, A. J. First Lessons in Arithmetic. New York, American Book Co. 150 p. 12°. 36 cents.
SETH, James. Freedom as Ethical Postulate. Edinburgh, Blackwood. 48 p. 8°.
SMITH, J. Bucknall. A Treatise upon Wire, Its Manufacture and Uses. New York, Wiley. 347 p. 4°. $3.
STEWART, S. T. Plane and Solid Geometry. New York, American Book Co. 406 p. 12°. $1.12.
WINSLOW, I. O. The Principles of Agriculture for Common Schools. New York, American Book Co. 152 p. 12°. 60 cents.


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— A third edition has recently appeared of Frazer's "Tables for the Determination of Minerals." This book is based, as is well known to many *Science* readers, on one by Weisbach, which was first published in 1866. The purpose is to aid the student in determining minerals by their physical properties as distinguished from the chemical reactions which they give. That it is possible so to arrange tables that it shall be in the main possible, by their use, for the student to determine a mineral from its color, lustre, streak, hardness, crystalline form, and cleavage, has been shown by the reception which this book has had through its various editions. Many know how much that was antiquated in chemical science has clung to the text books of mineralogy, and it was one of Dr. Frazer's aims in the production of this new edition of his "Tables" to eliminate all of this old and substitute formulas, etc., more in accordance with the present state of chemical science, The book is well known, so it seems unnecessary to commend it to our readers more than by saying that this edition is to a great extent quite new (Philadelphia, Lippincott).

— The American Book Company has published "The Principles of Agriculture for Common Schools," by J. O. Winslow. This is quite a departure from the usual run of school books, and will interest many who wish to see the elements of science taught in the schools. The book is not limited to what would usually be called agricultural science, but contains snatches from all branches of science which have a bearing on agriculture.


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